

WHAT IS CLAIMED IS:

1. A surface acoustic wave filter comprising  
series-arm resonators and parallel-arm resonators  
5 that are connected in a ladder-like fashion,  
the surface acoustic wave filter satisfying  
conditions expressed as:

$$1 \times 10^6 \leq 4\pi^2 f_0^2 R^2 C_{op} C_{os} \leq 3.1 \times 10^6$$

10 where  $C_{op}$  is an electrostatic capacitance of the  
parallel-arm resonators,  $C_{os}$  is an electrostatic  
capacitance of the series-arm resonators,  $f_0$  is a  
center frequency, and  $R$  is a nominal impedance.

15 2. A surface acoustic wave filter comprising  
series-arm resonators and parallel-arm resonators  
that are connected in a ladder-like fashion,  
the surface acoustic wave filter satisfying  
20 conditions expressed as:

$$1.3 \times 10^6 \leq 4\pi^2 f_0^2 R^2 C_{op} C_{os} \leq 3.1 \times 10^6$$

25 where  $C_{op}$  is an electrostatic capacitance of the  
parallel-arm resonators,  $C_{os}$  is an electrostatic  
capacitance of the series-arm resonators,  $f_0$  is a  
center frequency, and  $R$  is a nominal impedance.

30 3. A surface acoustic wave filter comprising  
series-arm resonators and parallel-arm resonators  
that are connected in a ladder-like fashion,  
the surface acoustic wave filter satisfying  
conditions expressed as:

$$35 \quad 1.6 \times 10^6 \leq 4\pi^2 f_0^2 R^2 C_{op} C_{os} \leq 2.9 \times 10^6$$

where  $C_{op}$  is an electrostatic capacitance of the

parallel-arm resonators,  $C_{os}$  is an electrostatic capacitance of the series-arm resonators,  $f_0$  is a center frequency, and  $R$  is a nominal impedance.

5           4.     The surface acoustic wave filter as claimed  
in claim 1, wherein the ratio  $C_{op}/C_{os}$  of the  
electrostatic capacitance  $C_{op}$  to the electrostatic  
capacitance  $C_{os}$  is 0.5.

10           5.     The surface acoustic wave filter as claimed  
in claim 1, wherein at least comb-like electrodes in  
the series-arm resonators and the parallel-arm  
resonators are covered with a dielectric film.

15           6.     The surface acoustic wave filter as claimed  
in claim 1, wherein the center frequency  $f_0$  is in the 5  
GHz band.

20           7.     The surface acoustic wave filter as claimed  
in claim 1, wherein the series-arm resonators and the  
parallel-arm resonators are connected to form a four-  
stage structure.

25           8.     A filter device comprising:  
a surface acoustic wave filter: and  
a package to which the surface acoustic wave  
filter is mounted by a wire bonding technique,  
the surface acoustic wave filter including  
series-arm resonators and parallel-arm resonators that  
30 are connected in a ladder-like fashion,  
the surface acoustic wave filter satisfying  
conditions expressed as:

$$1 \times 10^6 \leq 4\pi^2 f_0^2 R^2 C_{op} C_{os} \leq 3.1 \times 10^6$$

35           where  $C_{op}$  is an electrostatic capacitance of the  
parallel-arm resonators,  $C_{os}$  is an electrostatic

capacitance of the series-arm resonators,  $f_0$  is a center frequency, and  $R$  is a nominal impedance,

the package having a signal terminal connected to signal electrodes of the surface acoustic wave filter with one bonding wire, and

the bonding wire having an inductance  $L_i$  that satisfies conditions expressed as:

$$0.7 \leq L_i \leq 1.3.$$

10

9. A filter device comprising:

a surface acoustic wave filter: and

a package to which the surface acoustic wave filter is mounted by a wire bonding technique,

the surface acoustic wave filter including series-arm resonators and parallel-arm resonators that are connected in a ladder-like fashion,

the surface acoustic wave filter satisfying conditions expressed as:

20

$$1.3 \times 10^6 \leq 4\pi^2 f_0^2 R^2 C_{op} C_{os} \leq 3.1 \times 10^6$$

where  $C_{op}$  is an electrostatic capacitance of the parallel-arm resonators,  $C_{os}$  is an electrostatic capacitance of the series-arm resonators,  $f_0$  is a center frequency, and  $R$  is a nominal impedance,

the package having a signal terminal connected to signal electrodes of the surface acoustic wave filter with one bonding wire, and

the bonding wire having an inductance  $L_i$  that satisfies conditions expressed as:

$$0.7 \leq L_i \leq 1.3.$$

35

10. A filter device comprising:

a surface acoustic wave filter: and

a package to which the surface acoustic wave

filter is mounted by a wire bonding technique,  
the surface acoustic wave filter including  
series-arm resonators and parallel-arm resonators that  
are connected in a ladder-like fashion,

5 the surface acoustic wave filter satisfying  
conditions expressed as:

$$1.6 \times 10^6 \leq 4\pi^2 f_0^2 R^2 C_{op} C_{os} \leq 2.9 \times 10^6$$

10 where  $C_{op}$  is an electrostatic capacitance of the  
parallel-arm resonators,  $C_{os}$  is an electrostatic  
capacitance of the series-arm resonators,  $f_0$  is a  
center frequency, and  $R$  is a nominal impedance,  
the package having a signal terminal connected to  
15 signal electrodes of the surface acoustic wave filter  
with one bonding wire, and  
the bonding wire having an inductance  $L_i$  that  
satisfies conditions expressed as:

20  $0.7 \leq L_i \leq 1.3.$

11. A filter device comprising:  
a surface acoustic wave filter: and  
a package to which the surface acoustic wave  
25 filter is flip-chip mounted,  
the surface acoustic wave filter including  
series-arm resonators and parallel-arm resonators that  
are connected in a ladder-like fashion,  
the surface acoustic wave filter satisfying  
30 conditions expressed as:

$$1 \times 10^6 \leq 4\pi^2 f_0^2 R^2 C_{op} C_{os} \leq 3.1 \times 10^6$$

where  $C_{op}$  is an electrostatic capacitance of the  
35 parallel-arm resonators,  $C_{os}$  is an electrostatic  
capacitance of the series-arm resonators,  $f_0$  is a  
center frequency, and  $R$  is a nominal impedance,

the package having a signal line formed by a microstrip line, and

the microstrip line having an inductance  $L_i$  that satisfies conditions expressed as:

5

$$0.7 \leq L_i \leq 1.3.$$

12. A filter device comprising:

a surface acoustic wave filter: and

10 a package to which the surface acoustic wave filter is flip-chip mounted,

the surface acoustic wave filter including series-arm resonators and parallel-arm resonators that are connected in a ladder-like fashion,

15 the surface acoustic wave filter satisfying conditions expressed as:

$$1.3 \times 10^6 \leq 4\pi^2 f_0^2 R^2 C_{op} C_{os} \leq 3.1 \times 10^6$$

20 where  $C_{op}$  is an electrostatic capacitance of the parallel-arm resonators,  $C_{os}$  is an electrostatic capacitance of the series-arm resonators,  $f_0$  is a center frequency, and  $R$  is a nominal impedance,

25 the package having a signal line formed by a microstrip line, and

the microstrip line having an inductance  $L_i$  that satisfies conditions expressed as:

$$0.7 \leq L_i \leq 1.3.$$

30

13. A filter device comprising:

a surface acoustic wave filter: and

a package to which the surface acoustic wave filter is flip-chip mounted,

35 the surface acoustic wave filter including series-arm resonators and parallel-arm resonators that are connected in a ladder-like fashion,

the surface acoustic wave filter satisfying conditions expressed as:

$$1.6 \times 10^6 \leq 4\pi^2 f_0^2 R^2 C_{op} C_{os} \leq 2.9 \times 10^6$$

5

where  $C_{op}$  is an electrostatic capacitance of the parallel-arm resonators,  $C_{os}$  is an electrostatic capacitance of the series-arm resonators,  $f_0$  is a center frequency, and  $R$  is a nominal impedance,

10 the package having a signal line formed by a microstrip line, and

the microstrip line having an inductance  $L_i$  that satisfies the conditions expressed as:

15  $0.7 \leq L_i \leq 1.3.$

14. The filter device as claimed in claim 8, wherein the ratio  $C_{op}/C_{os}$  of the electrostatic capacitance  $C_{op}$  to the electrostatic capacitance  $C_{os}$  is  
20 0.5.

15. The filter device as claimed in claim 8, wherein at least comb-like electrodes in the series-resonators and the parallel-resonators are covered with  
25 a dielectric film.

16. The filter device as claimed in claim 8, wherein the center frequency  $f_0$  is in the 5 GHz band.

30 17. The filter device as claimed in claim 8, wherein the series-arm resonators and the parallel-arm resonators are connected to form a four-stage structure.

18. The filter device as claimed in claim 8,  
35 wherein the package is made of ceramics.